CLAIMS

1. **PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK**, comprising various user kits **(A, B,...X)** and a head-end **(1)** in two way communication by means of the electricity network **(2)**, where the upstream channel is that which runs from the user kits **(A, B,...X)** to the head-end **(1)** and the downstream channel that which runs from the head-end **(1)** to the user kits **(A, B,...X)**, and each one of the kits **(A, B,...X)**, **(1)** contains a medium access controller (MAC) **(3,4)** to maximize the quantity of information that the user kits **(A, B,...X)** can transmit and to minimize time latency in these kits **(A, B,...X)**; and where the electricity network is divided for the upstream and downstream channels by frequency division duplexing (FDD) and/ or time division duplexing (TDD), characterized in that it supports:

- access by various user kits **(A, B,...X)** in the upstream channel and the simultaneous sending of various information links by the head-end **(1)** in the downstream channel by means of multiplexing OFDMA/TDMA/CDMA, multiplexing by orthogonal frequency division, multiplexing by time division and or multiplexing by code division;
- criteria to dynamically assign each carrier in the OFDM system, multiplexing by orthogonal frequency division, to the user, and between the users with information to send at that moment with greater transmission capacity in this carrier, more bits per carrier or better signal-to-noise ratio, so as to maximize the transmission capacity in both the upstream and downstream channels, that is, to equalize or level the response in frequency observed by the head-end in both

emission and in reception;

- adjust quality of service (QoS) depending on the type of information and the users that require the transmission, where this quality of service is adaptable according to the frequency response at different moments and to the different distances between the user kits **(A, B,...X)** and head-end kit **(1)**;
- dynamically assign available bandwidth between the various communication requests by constantly calculating and monitoring the signal-to-noise ratio observed by the user kits **(A, B,...X)** and by the head-end kit **(1)** over the whole bandwidth of the system; so that transmission resources, this is the combined number of carriers in the system OFDM, are distributed according to the transmission needs at each moment in time for each user, the quality of service (QoS) parameters established for this user, the criteria to maximize the total capacity of the system and the criteria to minimize transmission latency, using for this the redistribution of the carriers of one symbol between the users (OFDMA), in time (TDMA), that is symbol to symbol, and by code (CDMA), optimising said redistribution by constant monitoring of the quality parameters for the electricity line, which vary contantly.

2. **PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK**, according to Claim 1, characterized in that it includes the maximization means, that is, means to equalize or level the frequency response seen by the head-end kit **(1)** both in emission and reception, [due to the fact that the electricity line acts as a selective channel in frequency between one point and another, causing certain frequencies to demonstrate greater

signal/noise (S/N) ratio and therefore greater transmission capacity than others, so that for some users some frequencies will be those that demonstrate greater S/N ratio, while for other users, the frequencies will be different]; where said maximization as mentioned consist of:

- specification for a vector space of equal size to the number of carriers in the OFDM channel, where the elements that make up this space are the number of bits per carrier that each user can see in each one of the carriers or the dimension of the constellation used in each carrier; $\mathbf{v_i}=[\mathbf{v_{i1}},\mathbf{v_{i2}}\ldots\mathbf{v_{in}}]$ where N is the total number of carriers utilized in the communication link which refers to the vector and v_{ix} represents the number of usable bits per carrier in the communications from or to the user $_i$, depending on which link is referred to, in the carrier $_x$ from the point of view of the head-end;
- distribution of the carriers between the users with information to send so as to maximize the norm one for this vector: $\|v\|$, where v the vector of bits per carrier, or dimension of the constellation or each carrier, that each head-end kit uses in the current symbol, both in the upstream and the downstream;
- grouping of the total number of carriers N, of the upstream and downstream in subchannels of the M carriers to simplify the calculation of the algorithm and the implementation, so as to reduce the dimension of vector space, generating a vector space with the dimensions N/M, where the values of the coordinates are the sum of all the carriers in the sub-channel, and giving as a result the capacity of transmission per OFDM symbol that each user sees in each sub-channel;
- adjust the width of the subchannels to the coherent bandwidth, defined as the difference of the frequencies

between the frequency position of the first and last carrier in which the variation in the frequency response in these carriers is less than a certain threshold.

3. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 1, characterized in that the MAC **(4)** in the head-end **(1)** includes an arbitration block **(5)** or arbiter responsible for the dynamic distribution of bandwidth in the upstream and downstream channels for the various communications from the user kits **(A, B, ...X)** where the criterion used by this arbitration block to dynamically assign, the transmission bandwidth are those previously described, and for which the following means are employed:

- packet oriented transmission, preceeded by a header indicating to which user the transmission is directed and in which conditions;
- upstream and downstream channels are divided into subchannels so that users are multiplexed to maximize bandwidth transmission for both the upstream and downstream channels, using the criteria of orthogonal transmission capacity in function of frequency and the various users;
- dynamic assignation, that is varying over time, of carriers to the various users, so that:
  - in the downstream link the headers of each packet sent by the sub channel indicates, among other things, the destination, the size and the constellation used, so that the users must be capable of detecting and understanding all the headers received by whatever subchannel, while only demodulating the information from the packet directed to them knowing the vector of bits per carrier used

in the modulation;

- in the upstream link, apart from the division in subchannels adjusted to the coherent bandwidth, division in time occurs such that a SLOT is defined as the number of symbols in the upstream channel between two allocation messages of these SLOTS (SAM), and which constitute the units used by the arbiter **(5)** to assign resources to the users, where these resources are periodically assigned by sending allocation messages, known as SAM, by the downstream link towards a user kit **(A, B, ...X)**, which may include information of one or more SLOTS and which are periodically sent to a determined number of samples before the SLOTS to which they refer, that is, they precede them temporarily, so that if the number of symbols of a SLOT is small then the latency floor that can be obtained is also small but the complexity of the system is greater as is the cost of the transmission capacity in the upstream channel in resources allocation messages (SAM);
- continuous measuring of the signal-to-noise ratio for each user in all the upstream as well as downstream channels, to continually update the capacity of the transmission for all the users in each one of the subchannels;
- continuous information regarding which users **(A, B,...X)** wish to make transmission and in what quantities by means of interrogation, that is to say, by POLLING, SLOTS and resource petition messages (MPR) respectively, where the upper layers of the head-end **(1)** in the upstream are those that inform the arbiter **(5)** of the quantity of information pending transmission and from which users; and,
- information on the QoS, bandwidth and latency, defined for each user in function of the channel capacity and

the number of users hanging from the head-end kit **(1)**, so that the number of SLOTS continuously assigned to a single user can be limited in cases where various users want to transmit at a given moment, thereby maintaining equality of access for users in the upstream connection.

4. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 3, characterized in that when the head-end kit **(1)** wants to transmit to one or more user kits **(A, B,...X)** via the downstream channel, the arbiter block **(5)** dynamically distributes bandwidth, using one or more of the subchannels referred to, and it advises of the destination of use this or these subchannels by means of the headers in the information packets sent by the subchannels, for this each user kit decodes the corresponding data when it detects that one of the said headers refers to a packet directed to it, so a user kit **(A, B,...X)** can receive more than one packet from various distinct subchannels, being able to indicate to this header the transmission of a new packet to the user or that the sub channel where the header is sent will be used to accelerate the transmission of a packet sent previously by another sub channel or subchannels to the same user, by means of aggregating the carriers of this new sub channel and those already used for the transmission of the previous packet.

5. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 4, characterized in that headers sent by the subchannels in the downstream connection are modulated preferably with modulations that have few signal-to-noise ratio requirements for their decoding,

preferably DPSK, differential phase modulation, and/or QPSK, quadrature phase modulation, along with error correction/detection codes and frequency diversity, sending of the same information in different carriers, and/or time diversity, sending the same information at different moments, to increase the probability of correctly decoding the said header.

6. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 4, characterized in that the headers already referred to include all the information necessary for the appropriate information packet, such that the destination, packet types, the use of diversification in frequency and/or in time, if the packet is destined for one user or for various users, MULTICAST mode, and or all users, BROADCAST mode, the modulation used for each carrier, if FEC redundancy has been employed, error correction/detection code, to protect the information packet, and/or if the sub channel to which the header is sent will be used to accelerate the transmission of information from a packet sent previously by another sub channel, or other information.

7. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 3, characterized in that the SLOTS where the upstream connection is divided, may be used by the user kits **(A,B,...X)** for:

- the transmission of requests to interrogation messages, POLLING;
- the transmission of resource petition messages (MPR),
- the transmission of data including one or all of the following:
  - synchronization sequences,

- equalization sequences,
- sequences to estimate signal-to-noise ratio, and/or
- data on information that the user **(A,B,...X)** wants to send to the head-end **(1)**.

8. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 3, characterized in that in the upstream connection the arbiter **(5)** of the head-end **(1)** includes the means to provide each user kit **(A,B,...X)** with the most adequate bandwidth in variable form, offering more or less SLOTS according to parameters such as the amount of information to be sent, the quality of service requested, the type of information to be sent, the signal-to-noise ratio observed by the users in the SLOTS conceded, and others, by means of an optimum assignation algorithm of SLOTS and communicating the decisions taken by said arbiter **(5)** to the user kits **(A, B,...X)** using SAM messages.

9. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 3, characterized in that the method used to communicate decisions on the distribution of SLOTS in the upstream connection as taken by the arbiter **(5)** of the head-end **(1)** is the sending of assignation messages SAM by the downstream connection to each user kit **(A,B,...X)**, and can include information on one or various SLOTS, be sent periodically and always with a determined number of samples before the SLOTS to which they refer, that is, they temporarily precede them, including at least:

- the indication of the user or users **(A,B,...X)** to which each SLOT is given,
- to indication of the use to which each SLOT is to be put,

- the number of symbols inside the SLOT that will be given to each user,
- the number of the symbol starting from which each user may use the SLOT,
- information on the modulation that must be used for the transmission of data, preferable QPSK or a constellation negotiated with the head-end kit **(1)** for a determined error task in function of the signal-to-noise ratio in the channel;

it may also include:

- confirmation of reception of resource petition messages (MPR),
- restriction of access to determined user kits **(A,B,...X)**,
- the correction of detours in the temporal transmission window of the user kits **(A,B,...X)**,
- information on power control,
- the type and number of data to be sent by the user, that is if 0 or more equalization or synchronization symbols are to be sent and an estimation of the sound/noise and/or the data in the information where these SAM messages are preferably coded with some extra protection against errors, such as codes with a greater capacity for correction/detection of errors, diversity in frequency or time, and other systems.

10. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 3, characterized in that in the downstream channel, the arbiter **(5)** undertakes the distribution function taking into account parameters such as the signal-to-noise ratios, or the frequency response, that the user kits **(A,B,...X)** observe in the subchannels, the message priority, the quantity of information, among others; while the users decode the headers sent via the downstream connection and decide if they must take the

data sent by the same sub channel as the header, starting from the information on the destination, including said header.

11. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 10, characterized in that the arbiter **(5)** may order the use of one or more additional subchannels for the corresponding dispatch, or to increase the bandwidth of a user, the objective being to speed up the transmission of the packet referred to, assigning more than one sub channel to transmit more than one packet of information at a time, indicating either of these decisions by means of the header in the messages dispatched.

12. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 10, characterized in that the arbiter **(5)** may distribute the users **(A, B,...X)** on the various subchannels, in both the upstream and the downstream, such that the bandwidth used is maximised at each moment, based on the frequency response that each user **(A, B, ...X)** may observe in the various subchannels.

13. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 9, characterized in that for the upstream and downstream channels, the arbiter **(5)** uses QoS as one of the criteria, at the time of assigning resources to minimize latency, that is, each user kit **(A, B, ...X)** transmits as soon as possible after placing an access request in the upstream connection, or that a packet is transmitted from the head-end kit **(1)** to a user **(A, B, ...X)** as quickly as possible.

14. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 3, characterized in that the MPR message, is preferably a relatively short control message to inform if a user kit **(A, B, ...X)** wants to transmit data and optionally of the size of the information block to be sent and the quality of service required by the user kit **(A, B; ...X)** during the following moments:

- when a SAM message received by the user kit **(A, B, ...X)** indicates that the next SLOT assigned to said kit is the last in a series of data transmission SLOTS, the user kit **(A, B, ...X)** uses part of the SLOT to send an MPR message in case that it has more data to transmit,
- when the user kit **(A, B, ...X)** has not more data to send and still has SLOTS assigned, in this case the corresponding MPR message will indicate to the head-end **(1)** not to assign to it more SLOTS and to reassign the remaining SLOTS to other user kits **(A, B, ...X)**,
- when a user kit **(A, B, ...X)** is assigned a SLOT, by means of a SAM, dedicated to the petition of resources (MPR), so that the user kit/s **(A, B, ...X)** that want to transmit, send their MPR to this SLOT, using a small part of this randomly or by means of a determined algorithm that takes into account the type of user, the type of information and other parameters; and the manner in which the head-end kit **(1)** detects possible collisions when various user kits coincide in the petition of resources in the same zone of the SLOT, such collisions are resolved by means of algorithms known in the prior art or by leaving the user kits **(A, B, ...X)** retransmit their positions in later intervention until competition between users **(A, B, ...X)** is resolved.

15. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 3 characterized in that, said POLLING SLOTS allow a maximum number of users **(A, B, ...X)** to be questioned on whether or not they have information to transmit by using an interrogation algorithm the purpose being that the same user kits **(A, B, ...X)** are not always those questioned when said maximum number is surpassed, including in the head-end **(1)** itself means to classify the user kits into various categories depending on the activity that the users demonstrate, and to obtain this information the head-end **(1)** assigns interrogation SLOTS, POLLING, to those users on whose activity it requires information and these respond in the part of the SLOT allocated to them when they have information to send.

16. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 7, characterized in that when a user kit **(A, B, ...X)** has data to send it waits until a message (SAM) announces that one of the following SLOTS is destined for POLLING or MPR, so that if it receives a POLLING SAM the following steps are taken:

- the user kits **(A, B, ...X)** verifies certain bits in the SAM that indicate if it belongs or not to the group of users than may use the next POLLING SLOT,
- the SAM message indicates the positions in which the user kit **(A, B, ...X)** must reply to the resource request, these positions being determined by the head-end kit **(1)** that constantly monitors the signal-to-noise ratio and that can be seen by user kit **(A, B, ...X)** in the various carriers, available frequencies for the upstream communication;
- the POLLING SLOT is divided in various valid zones that

are small portions of time/frequency, and the user kits **(A, B, ...X)** select the zone indicated by the SAM so as to avoid a collision of petitions;

- the user kit **(A, B, ...X)** send a POLLING message in the selected zone; and
- if the said POLLING has been received in the head-end kit **(1)**, the user kit **(A, B, ...X)** will later receive SAM messages assigning SLOTS; while if it has not received them, the user kit **(A, B, ...X)** will have to wait until there is a new POLLING SAM; while if it has received an announcement of an MPR SLOT in a SAM, the user kit **(A, B, ...X)** will send the MPR message in said SLOT where apart from the necessity to transmit, it indicates, preferably, the size of the information that it wants to send, the priority, the QoS required, so said information may be decoded by the header and can be used to optimise the algorithm for the assignation of arbitrage SLOTS **(5)**; having foreseen that if the head-end **(1)** detects collision it will begin an algorithm to resolve this collision or wait for the user kits **(A, B, ...X)** to transmit their petition in another MPR SLOT or POLLING, since the arbiter **(5)** does not grant any data transmission SLOT in the following SAM.

17. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 2, characterized in that in transmission the user kits **(A, B, ...X)** follow the decisions taken by the head-end **(1)** regarding the moment to transmit, the carriers to be used, the type of modulation and other parameters, according to the following process:

- having correctly received the transmission requests from a user kit **(A, B, ...X)**, the head-end **(1)** assigns

sufficient time/frequency SLOTS starting from an estimation made according to the activity, transmission capacity, quality of service and other parameters of the user kit **(A, B, ...X)** that made the petition and according to the signal-to-noise ratio monitored in the sub channel the arbiter **(5)** being responsible for the distribution of SLOTS between the users that made the petition to send data with the algorithm previously mentioned;

- when a user kit **(A, B, ...X)** detects, by means of demodulation and decoding the SAM message that one or more SLOTS are destined for it, it undertakes the following operations:
  - checks the type of each one of the SLOTS assigned and the modulation that must be used in each carrier of each SLOT, the SAM message being responsible for the communication of this information according to that assigned by the arbiter **(5)**;
  - calculates how many bits it will be able to transmit in total, and extracts the data from its memory, these being information on data, equalization, synchronization, estimation of sound/noise or any other combination of these, as is indicated in the SAM message assigned to this SLOT;
  - waits for the start symbol on the part of the SLOT that must transmit and undertakes the transmission of data with the modulation selected;
  - if any of the SLOTS assigned is of the type diversity in time or in frequency, the user kit **(A, B, ...X)** must transmit the modulated information in secure form, preferable QPSK, repeated various times in frequency, that is to say, transmitting the same information from carrier k in the carriers k+N, k+2*N, etc, depending on the diversity used and the carriers assigned, or repeated various times at

various moments, time diversity;

- if the SLOT is a POLLING or MPR type the process previously specified in Claim 16 is used.

18. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 1, characterized in that the CDMA multiplexing, already referred to, includes a frequency hopping method that if applied to the carriers then the user kits **(A, B, ...X)** in the moment of transmission only use some of the carrier according to a sequence that indicates at each instant the carriers that may be used to send information, this sequence being predefined and being capable of being generated by a pseudorandom sequence whose seed is communicated by means of SAM messages, while if the said method is applied to the subchannels, the sequence is used to indicate to the user kit **(A, B, ...X)** which sub channel must be used to transmit at each moment in time.

19. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 3, characterized in that the information packet headers send by the SLOTS in the upstream connection are modulated, preferably with modulations that for decoding have low signal-to-noise ratio requirements, such as DPSK, differential phase modulation, and/or QPSK, phase modulation in quadrature, along with correction codes/ error detection and frequency diversity, sending of the same information over distinct carriers, and/or time, sending the same information at different moments, to increase the probability of correct decoding.

20. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION

OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 3, characterized in that the headers, include all the information necessary on the corresponding information packet, such as information on packet type, use of frequency and/or time diversity, the modulation used to modulate the information in the packet, for example all carriers in QPSK or all carriers with the constellation fixed for a determined error rate in function of the signal-to-noise ratio on the channel after each user has been negotiated with the head-end, and the FEC redundancy, code correction redundancy/error detection, with which the information in the packet is protected, among others.

21. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim **3,** characterized in that it includes a series of controls to maximize the signal-to-noise ratio for all users without penalizing any of the them during the transmission thereby allowing multiple access in the same OFDM symbol and in the upstream connection and the transmission of multiple information packets simultaneously in the downstream connection; said controls being:

- control of the injected power for each user kit **(A, B, ...X)**;
- control of the time window for each user kit **(A, B, ...X)**;
- control of the sample frequency, that is the synchronization in frequency of the user kits **(A, B, ...X)**.

22. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 21, characterized in that automatic

gain control and/or a power mask is used on these controls on the injected power by which the signals from the users kits **(A, B, ...X)** arrive at the head-end **(1)** with approximately the same power, so that one can work with converters A/D, analog/digital, with few bits without loosing the signal-to-noise ratio in reception.

23. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 21, characterized in that the window control is used to control the signals from the various users **(A, B, ...X)** that arrive at the head-end **(1)** at the same time, that is, the start of all the OFDM symbols sent arrive in the same time window at the head-end **(1)**; this control is made by means of:

- an adjustment in the open loop that occurs in the downstream channel, and which represents a rough adjustment in the time window and in which each user kit **(A, B, ...X)** can see that packets that arrive via the downstream channel, and from which the samples that have to be delayed/advanced in transmission are approximately deduced so that they arrive at the head-end **(1)** at the optimum moment;
- an adjustment in the closed loop that occurs in the upstream channel and in the downstream by means of the SAM messages that represent a fine adjustment in the time window and in which the head-end kit **(1)** detects and communicates the number of samples that must be delayed/advanced by the user kit **(A, B, ...X)** to reach the optimum moment for transmission.

24. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 21, characterized in that, in the said frequency control and following synchronization, each user kit **(A, B, ...X)** knows the sample frequency used by

the head-end **(1)**, which it then uses to correct the transmission in the upstream channel so that frequency error in reception is null; the following methods are used to correct transmission frequency in the users kits **(A, B, ...X)**:

- residual error correction in the carriers by means of a rotor, that compensates the rotation that each carrier suffers, multiplying each carrier by the complex exponential of the desired angle; and
- sample frequency correction by means of a frequency corrector element, that may consist of a resampler in the digital treatment part of the system, and/or in the variable oscillator or VCXO in the analog part, taking into account that if the corresponding clocks are sufficiently precise it is not necessary to use said frequency corrector element, it being sufficient simply to correct the residual error in the carriers with the rotor previously referred to.

25. PROCESS FOR MULTIPLE ACCESS AND MULTIPLE TRANSMISSION OF DATA POINT TO MULTIPOINT OVER THE ELECTRICITY NETWORK, according to Claim 7, characterized in that the method used to communicate decisions on the distribution of SLOTS in the upstream connection as taken by the arbiter **(5)** of the head-end **(1)** is the sending of assignation messages SAM by the downstream connection to each user kit **(A,B,...X)**, and can include information on one or various SLOTS, be sent periodically and always with a determined number of samples before the SLOTS to which they refer, that is, they temporarily precede them, including at least:

- the indication of the user or users **(A,B,...X)** to which each SLOT is given,
- to indication of the use to which each SLOT is to be put,

- the number of symbols inside the SLOT that will be given to each user,
- the number of the symbol starting from which each user may use the SLOT,
- information on the modulation that must be used for the transmission of data, preferable QPSK or a constellation negotiated with the head-end kit **(1)** for a determined error task in function of the signal-to-noise ratio in the channel;

it may also include:

- confirmation of reception of resource petition messages (MPR),
- restriction of access to determined user kits **(A,B,...X)**,
- the correction of detours in the temporal transmission window of the user kits **(A,B,...X)**,
- information on power control,
- the type and number of data to be sent by the user, that is if 0 or more equalization or synchronization symbols are to be sent and an estimation of the sound/noise and/or the data in the information where these SAM messages are preferably coded with some extra protection against errors, such as codes with a greater capacity for correction/detection of errors, diversity in frequency or time, and other systems.